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2 ALTERNATIVES

This EIS analyzes the potential impacts of implementing the restoration alternatives. The alternatives being evaluated in this EIS are (1) No Action, (2) multi-species approach, and (3) single species (chinook salmon) alternative.

The analysis in this EIS applies to the alternatives and the various types of actions that would be utilized to achieve restoration, but it does not consider individual site-specific actions. Appropriate project-specific environmental analysis will be conducted for all future restoration activities in accordance with NEPA and SEPA.

Construction of the restoration projects under the selected alternative would begin in 2001 and would be completed by 2011. Operation of the selected alternative would occur for 50 years, from 2011 to 2061, the effective operational life for alternative projects.

This EIS does not address river flows or mitigation or restoration activities identified and being undertaken as a result of the Howard Hanson Dam Additional Water Storage Project Final Feasibility Study and EIS (Corps 1998a) or under other programs.

This section:

- describes related studies that would be needed to implement the ERS,
- discusses the history of the study area,
- describes the alternatives analyzed in this EIS, as well as those considered but eliminated from further study, and
- explains criteria used to assess the alternatives.

2.1 Description of Alternatives

Three major programmatic alternatives were identified for analysis in the EIS through the ERS planning process:

- Alternative 1 - No Action,
- Alternative 2 - the multi-species (i.e., fish and wildlife) approach, and
- Alternative 3 - the single threatened fish species approach.

Three subalternatives have been identified for the multi-species and the chinook salmon species approaches. The alternatives and subalternatives are outlined in the following section.

2.1.1 Alternative 1: No Action

The No Action Alternative consists of the continuation of a variety of restoration activities under existing regulations and tribal, agency, and non-governmental organization restoration programs. Current independent management of the river basin by various agencies would continue, implementing activities under existing policies.

The goals of this alternative are to continue the implementation of project-by-project restoration activities through the current agency-based programs and also to achieve Endangered Species Act (ESA) or ESA-linked WRIA planning. The goals and objectives for restoration would be tied to those defined for each separate agency program rather than to the overarching goals of the river basin-based program. Additionally, under No Action, the geographic focus and how the restorations are implemented would also be tied to the individual programs.

The No Action Alternative assumes that efforts to improve fish habitat conditions throughout the Green/Duwamish River Basin would continue, but as a program of individual projects with limited funding opportunities. Restorations that do occur would most likely be as a part of single-jurisdiction actions based on location and funding opportunities rather than comprehensive resource need. Restoration aspects of No Action would include continued project-by-project restorations that would incrementally reduce barriers to fish passage, connect potential habitat and potential major spawning and rearing areas with the mainstem river, increase estuarine habitat, and increase streamside vegetation.

The geographic focus of this alternative would continue to be scattered throughout the Green River Basin, in much the same way as past projects.

This alternative would be implemented through the current ongoing agency/sponsor programs, funding sources and jurisdictions. Examples of current restoration programs include the Washington Department of Fish and Wildlife SHEER program (an inventory of anadromous fish blockages on streams within the state of Washington), restorations occurring as a part of the Elliott Bay Natural Resources Damage Assessment, programs initiated by the King Conservation District and Mid-Sound Fisheries, and programs initiated by the Muckleshoot Indian Tribe Fisheries Department.

Monitoring of restorations and restoration success would continue to be fragmented or non-existent because there is no mechanism to evaluate project successes, shortcomings, limitations, and contribution to ecosystem improvement.

The project evaluation criteria (i.e., rationale for selecting the locations and types of restorations) would be based on the wide range of factors currently used by the various agencies and groups involved in restoration in the Green River Basin. These evaluation criteria include such factors as available funding and manpower, site availability, site access, and ease of accomplishing the restoration.

A consequence of the No Action Alternative would be that, for a variety of reasons (e.g., funding limitations, issues of land ownership, and manpower limitations), restorations would be limited to a small number of projects rather than a program that would result in a more significant

cumulative contribution to resource restoration. Also, sites considered for restoration purposes under the Restoration Plan (Volume II) would be developed for other non-habitat purposes if the plan was not implemented.

2.1.2 Alternative 2: Multi-Species Approach (Preferred Alternative)

The Preferred Alternative would be a program to restore ecological resources and processes that would benefit multiple fish, riparian, and riverine-associated wildlife species. This alternative would focus on implementing a balance of activities that would not be at the expense of maintaining or improving successful populations of other species. This approach assumes restoration of larger areas of aquatic environment and riparian corridors, and providing connections to existing productive habitat that would otherwise not occur under the No Action Alternative. Implementing this approach would result in an increase in functional habitat for a group of species, thereby resulting in an increase in functional habitat of other species as part of a balanced natural ecosystem.

The goals of this alternative are the basin-wide restoration goals identified in Section 1 of this EIS:

- change the physical nature of existing degraded habitat,
- improve existing ecosystem functions and values, and
- address important factors limiting habitat productivity.

Under this alternative, the geographic focus will be at the basin level, with the intent to manage restoration based on the total resource need rather than through individual programs as would be the case under the No Action Alternative.

Examples of activities that would be conducted as part of Alternative 2 would include:

- Reducing barriers to fish passage - This activity would include reconnecting old channels by removing or relocating levees and other barriers in the middle Green River from the gorge to Auburn Narrows and the lower mainstem to the mouth (RM 57 to 0), and replacing or improving culverts on tributaries to benefit a variety of salmonids.
- Improving habitat forming processes - This activity would include retaining or importing sediment into the middle Green River, especially between Metzler O'Grady Park and Auburn Narrows and importing large woody debris into the middle and lower Green River (RM 42 to 0), in side channels, and in tributaries.
- Increasing channel diversity - This activity would include improving the channel cross sections in all tributaries, but particularly Smay, Sunday, Soos, Burns, and Newaukum Creeks; and the entire Green River. Channel diversity would also be improved by increasing tributary flows into the mainstem and implementing channel-forming flows in the middle and lower mainstem (RM 60 to 0).

- Improving estuarine habitat - Habitat would be increased by creating deltaic habitat in saltwater areas that would benefit a variety of species including epibenthic organisms and a variety of fish species and their prey.
- Increasing streamside vegetation - Streamside vegetation would be increased by planting along tributaries, especially the North Fork of the Green River, on Smay Creek, Sunday Creek; along side channels; and along the entire mainstem of the Green River.

This alternative would be implemented through the Green/Duwamish River Ecosystem Restoration Program administered jointly by the Corps of Engineers and King County.

Under this alternative, monitoring of restorations and restoration success would be accomplished from a basin (ecosystem) approach, utilizing the monitoring protocol and GIS database program developed as a part of the ERS.

Candidate projects have been identified and evaluated by the Environmental Restoration Study Team (ERST) using project evaluation criteria (rationale for selecting the locations and types of restorations). The ERST (consisting of a panel of biologists and other technical staff from the Corps, King County, the Muckleshoot Indian Tribe Fisheries Department, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and several of the basin cities) used the project selection criteria to evaluate the effectiveness of projects submitted by agencies and organizations. A feasibility analysis of the top-rated projects was conducted after evaluation and ranking of projects. The feasibility analysis included biological considerations along with design, cost, permitting, access, and land purchase factors. The 50 candidate projects evaluated are described in the Restoration Plan (Volume II). The project evaluation criteria (i.e., rationale for selecting the locations and types of restorations) are identified in Table 2-1.

The evaluation criteria in Table 2-1 would be used to evaluate additional candidate projects in addition to the 50 projects identified in the Restoration Plan. The scores for each project would then be compared with other candidates to establish priorities for implementation.

The following is an example of an application of the multi-species evaluation criteria for the proposed Horsehead Bend Side Channel project at RM 26.

- **Limiting Factors** - The Horsehead Bend Project would address Limiting Factors 2, 3, and 6 (see Table 2-1 for descriptions of limiting factors). The effectiveness (weighted by doubling score) was considered Medium/High (4 pts x 2 = 8);
- **Scale** - The scale of the project was evaluated as Medium (2 pts) and the Effect (weighted by doubling score) of the project also Medium (2 pts x 2 = 4);
- **Feasibility** – Technical Feasibility was evaluated as High (3 pts) and Political Feasibility was evaluated as Medium (2 pts);
- **Wildlife Benefit** – Evaluated as Medium (2 pts);
- **Overall Score** was 21 out of a maximum of 28 points.

**Table 2-1. Evaluation Criteria for Alternative 2 - Multi-Species Approach,
Green/Duwamish River Ecosystem Restoration Study**

Evaluation Criteria	Proposed Project
<p><u>Limiting Factors:</u></p> <p><i>How effective is the project at addressing one or more of the following limiting factors?</i> (maximum 10 points)</p> <ol style="list-style-type: none"> 1. Barriers to Fish Passage – Culverts, dams, and hatcheries 2. Reduction in Channel Forming Flows – loss of side channels and floodplain connections 3. Loss of Channel Diversity in Lower River – Levee and infrastructure have eliminated habitat 4. Loss of Estuarine Habitat – Filling for navigation and development has reduced the size of the estuary 5. Loss of Floodplain Habitat – Development and changes in flows have reduced floodplains connections 6. Reduction in Large Woody Debris – Log jams are now uncommon 7. Loss of Sediment Sources – Dam and construction of levees in floodplain reduced gravels for spawning habitat and leads to channel downcutting 8. Increase in Water Temperatures – Summer temperatures are stressful to fish <p><u>Scale:</u></p> <p><i>Project - How large (linear feet, area benefited) is the project?</i> (maximum 3 points)</p> <p><i>Effect – How far-reaching (e.g, linear feet of tributary to become accessible for spawning/rearing, etc.) is the project's effect?</i> (maximum 6 points)</p> <p><u>Feasibility:</u></p> <p><i>Technical - Does a reasonable restoration technique exist and is it widely accepted?</i> (maximum 3 points)</p> <p><i>Political – Is the proposal socially and politically acceptable and likely to be widely supported?</i> (maximum 3 points)</p> <p><u>Wildlife:</u></p> <p><i>Habitat - Does the project benefit wildlife?</i> (maximum 3 points)</p>	
Total Score* (maximum 28 points)	

***Scoring**

Limiting Factors Effectiveness - 1 to 5 points (Low, Low/Medium, Medium/High, High) and weighted by doubling score

Scale Effect -1 to 3 points (Low, Medium, High) and weighted by doubling score

All Other Categories- 1 to 3 points (Low, Medium, High) and no weighting

Table 3 in the Restoration Plan (Volume II) provides a complete evaluation and scoring of all 50 projects.

Three possible subalternatives for implementing the multi-species alternative include developing restoration projects that replicate natural processes with minimum future maintenance, implementing engineered projects, or an integrated approach that would include a combination of these methods. These subalternatives are as follows:

2.1.2.1 Subalternative 2A: Ecosystem/Habitat-Forming Method

The Ecosystem/Habitat-Forming Method emphasizes recreating natural forms and functions in the Green/Duwamish River Basin (rather than only specific, limited parts of the river). The intent would be to restore natural processes over a larger area of the basin so that critical habitat and water conditions more closely emulate those that existed prior to human disturbance. These activities would be implemented so that long-term maintenance or repeated reconstruction would be minimized.

Typical activities under this subalternative include the following:

- Eliminate barriers to passage for a variety of fish, providing access to miles of habitat, restoring interaction with the mainstem river, and opening major spawning and rearing areas from tributaries to the mainstem river.
- Increase channel diversity throughout the basin and reconnect critical habitat to the river.
- Establish areas of estuarine habitat that are needed to benefit a variety of organisms and species.
- Replant, improve, or expand riparian and vegetative buffers to benefit fish and wildlife.
- Construct habitat structures that provide complexity (e.g., both deep and shallow pools for adult and juvenile fish).
- Increase large woody debris quantities and recruitment to benefit a variety of salmonids in the river system.

- Replenish the sediment downstream of Howard Hanson Dam to alleviate one of the major habitat problems in the middle Green River.
- Increase or protect floodplain and wetlands habitat on the entire mainstem of the Green River and tributaries, especially Soos, Burns, and Newaukum Creeks.
- Protect or restore riparian zones on the tributaries, especially Soos, Burns, and Newaukum Creeks; the side channels; and on the middle and lower mainstem (RM 42 to 0).

2.1.2.2 Subalternative 2B: Engineered Design and Constructed Habitat Method

The Engineered Design and Constructed Habitat Method is an engineered, structured restoration approach that emphasizes water quality improvements and artificial propagation. Under this subalternative, a more focused method would be implemented (vs. an ecosystem/basin approach) that would determine what structures could be constructed to benefit a specific, smaller portion of the Green/Duwamish River. For example, an off-channel slough would be constructed in a highly urban area where previous human channelization of the river would not allow this to redevelop through natural processes. Similarly, if a species is severely reduced in abundance from loss of critical habitat, engineered restoration in combination with a reintroduction of a viable population would result in species recovery in that area.

Typical activities under this subalternative include the following:

- Identify areas where hardened surfaces would be removed to increase surface water filtration and groundwater infiltration.
- Construct nearshore habitat in Elliott Bay to provide more complex nearshore environment for salmonids, rockfish, and invertebrates.
- Improve fish passage by constructing more natural channels to replace existing concrete flumes.
- Construct habitat features in areas where historical habitat-forming processes have been disrupted.
- Construct artificial spawning channels by excavating new channels in the middle Green River, from the gorge to Auburn Narrows.
- Alter disrupted habitat features and habitat-forming processes by removing in-stream structures that have caused that disruption.

2.1.2.3 Subalternative 2C: Integrated Method

Under this subalternative, a combination of activities described under the Ecosystem/Habitat-Forming and Engineered Design subalternatives would be implemented. Areas of the basin would be studied to determine what combination of Ecosystem and Engineered habitat

restoration and water flow methods would be implemented to provide the most benefit to key species in that area, with the least environmental impacts.

2.1.3 Alternative 3: Single-Species Restoration (Chinook Salmon)

This alternative focuses on restoring fish habitat to benefit a single species, the threatened chinook salmon as identified by the National Marine Fisheries Service (NMFS) under the Endangered Species Act, rather than a multi-species restoration approach.

Over the past several decades, effort has been focused on improving specific plant and animal species populations and habitats under the Endangered Species Act (ESA). Recovery plans have been developed and implemented for such ESA-listed species such as the bald eagle, grizzly bear, northern spotted owl, and marbled murrelet. In March 1999, NMFS listed the chinook salmon as threatened. As a result, programs are currently underway to address the restoration of the species under ESA.

The single-species alternative is not meant to comply with all legal implications associated with recovery under the ESA, but rather addresses the actions that would be accomplished under a voluntary restoration effort focusing on (capital) habitat improvements that benefit chinook salmon. The program would not address all of the chinook recovery needs, but would make a significant improvement over current conditions.

The goals of this alternative are to implement capital improvement projects that would assist in increasing chinook populations in the Green River Basin in a manner consistent with regulatory requirements. These capital improvements would focus on improving life cycle requirements for the salmon within the Green River Basin and Duwamish Estuary. Restoration activities would be designed to increase the critical spawning and rearing habitat for and the number and/or distribution of chinook salmon.

Under this alternative, resource information on Green River chinook salmon (historic condition, current distribution and population, life history, habitat needs and population genetics) would continue to be gathered to further improve the restoration projects.

The geographic focus of this alternative would be for restorations within the primary chinook habitat -- along the mainstem and estuary, and associated side channels and large tributaries (Soos and Newaukem Creeks).

This alternative would be implemented through the Green/Duwamish River Ecosystem Restoration Program administered jointly by the Corps of Engineers and King County. The public, local, state, federal and tribal groups would be solicited to identify potential projects. A technical committee would use the project selection criteria (Table 2-2) to evaluate projects submitted by the various agencies and groups.

**Table 2-2. Evaluation Criteria for Alternative 3 - Single-Species Approach,
Green/Duwamish River Ecosystem Restoration Study**

Evaluation Criteria	Proposed Project
Adequate assurance of achieving project benefits (chance of success)	
Cost effective	
Socially and technically feasible including public acceptability, permitting, property ownership and adjacent land use	
Scale of project	
Considers interactions with other species	
Adaptable	
Genetic integrity, with emphasis placed on maintaining a diverse gene pool (double point score)	
Habitat Needs – both landscape perspective and site-specific (double point score)	
Total Score*	

* Score evaluation criteria from 1 to 10 (10 being the highest); weight genetic integrity and habitat needs as shown

After evaluation and ranking of projects, a feasibility analysis of the top-rated projects would be conducted. The feasibility analysis would include design, cost, permitting, access, and land purchase factors.

Under this alternative, monitoring of restorations and restoration success would be accomplished from a basin (ecosystem) approach, and utilizing the monitoring protocol and GIS database program developed as a part of the ERS. The monitoring plan would be based on the program goals and objectives, chinook use at the project sites, overall chinook population trends in the Green River Basin, and measurable improvements to chinook habitat components at the project sites.

This programmatic alternative would have three associated subalternatives: Ecosystem/Habitat-Forming, Engineered Design and Constructed Habitat, and an Integrated Approach.

2.1.3.1 Subalternative 3A: Ecosystem/Habitat-Forming Method

This alternative utilizes the actual processes within the Green River Basin that form chinook salmon habitat. Evaluation of geology, hydrology, sedimentation, and other processes would identify where the ecosystem approach would be used to improve habitat for chinook salmon.

Examples of projects under this alternative include:

- Reducing barriers to fish passage by reconnecting old channels, and removing or relocating levees and other barriers in the middle Green River from the gorge to Auburn Narrows and the lower mainstem to the mouth (RM 60 to 0).
- Increasing critical habitat by importing large-diameter gravels and cobble (1-inch to 6-inch diameter) into the middle Green River, especially between Metzler O'Grady Park and Auburn Narrows. This would also include importing and placing large woody debris to make deep pools in the middle and lower Green River (RM 42 to 0).
- Increasing streamside vegetation by planting along the entire mainstem of the Green River.
- Increasing or protecting floodplain and wetlands habitat on the entire mainstem of the Green River.

2.1.3.2 Subalternative 3B: Engineered Design and Constructed Habitat Method

When natural processes cannot achieve population levels or genetic integrity needed to maintain a stable population, surrogate actions would be pursued through engineering design and constructed habitat. Projects under this subalternative include hatcheries, artificial spawning channels, incubation ponds, and pumping of groundwater to augment flows. Examples include:

- Construct artificial spawning channels by excavating new channels in the middle Green River, from the gorge to Auburn Narrows. Large gravels and cobbles (1-inch to 6-inch diameter) would be placed in these channels.
- Construct hatcheries, if it can be demonstrated that they would increase the viability of key species.
- Alter disrupted habitat features and habitat-forming processes by removing in-stream structures within the mainstem that have caused that disruption.

2.1.3.3 Subalternative 3C: Integrated Method

Under this subalternative, a combination of activities described under the Ecosystem/Habitat-Forming and Engineered Design subalternatives would be implemented. Both scale and location of projects within the focus area would be evaluated. Areas of the basin would be studied to determine what combination of Ecosystem and Engineered habitat restoration and water flow methods would be implemented with the least environmental impacts and the most benefit to key species in that area.

2.2 Alternatives Considered But Eliminated from Detailed Study

The Corps and King County considered evaluating one other alternative (Return to Historic Conditions) in this EIS. This alternative was eliminated from detailed evaluation because it was not considered to be politically, socially, or economically feasible. The intent of the Historic Conditions Alternative would be to restore the basin as closely as possible to its original condition.

This alternative would have included, singly or in combination, the following components, several of which would be necessary to approach reestablishing historic conditions:

- Reroute the White River to the Green River, from the Puyallup River.
- Remove the Hiram Chittenden Locks to restore Lake Washington to its former higher level and, thereby, reconnect the Black and Cedar Rivers to the Duwamish River.
- Remove Harbor Island and the remainder of the industrial area and restore the Duwamish Estuary to its former condition.
- Remove the Howard A. Hanson Dam to restore flows to historic conditions and improve sediment transport in the basin.
- Remove the Tacoma Diversion Dam to restore flows to historic conditions and improve sediment transport in the basin.
- Remove Boeing Field to restore habitat.
- Modify flows or flow regimes from either Howard Hanson Dam or the Tacoma Diversion Dam.
- Remove levees at Tukwila and along the lower Green River to restore back channels, wetlands, and the floodplain.

None of these components are evaluated in this EIS.

2.3 Alternative Selection Criteria

To accomplish the goals of the alternatives, studies would be conducted to determine what types of habitats would most successfully benefit aquatic and riparian associated species in various parts of the Green/Duwamish River Basin. Restoration activities would then be selected and designed to maximize the benefits for the species. Criteria selected to evaluate the multi-species and single-species alternatives were presented in Tables 2-1 and 2-2. These matrices would be used as guides to determine restoration approaches and priorities. Activities that involved an integrated approach (Subalternatives 2C and 3C) would be examined in terms of landscape considerations. The evaluation criteria include limiting factor, scale, feasibility, and wildlife considerations. The scoring of limiting factors and scale aspects have been weighted as more important than the other categories (feasibility and wildlife).

As discussed in Section 2.1.2, the ERST has evaluated 50 projects that are candidates for implementation under Alternative 2. These projects and the evaluation are described in the Restoration Plan (Volume II).

Section 3 of this EIS describes the existing conditions where the above alternatives and activities would be implemented, for each natural and human environment element in the Green/Duwamish River Basin.